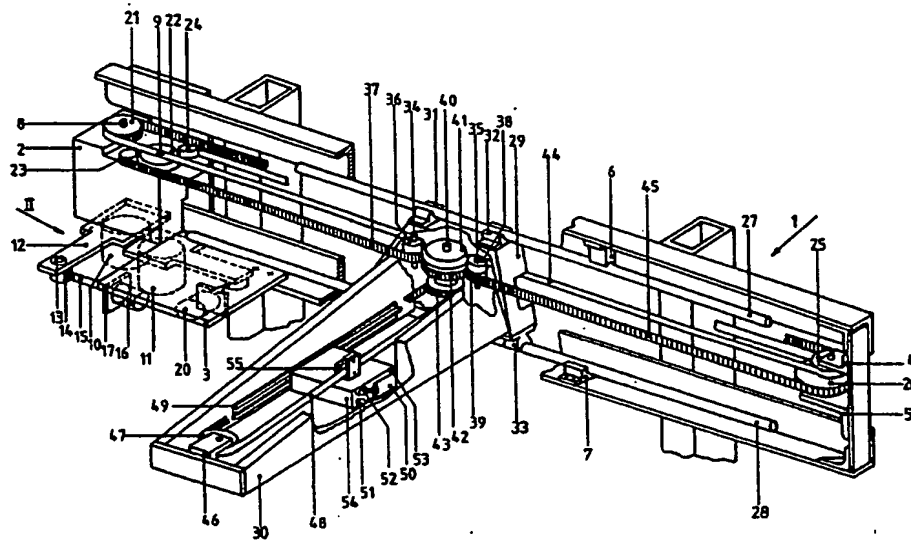




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: **ELEMENT MOVING DEVICE**

## (57) Abstract

The element moving device includes a supporting structure (29, 30) movable in the X-direction on guide rods (27, 28) and carrying an axle (40) on which an assembly comprising three gear wheels (41, 42, 43) is freely rotatable. Two wheels (41, 42) are engaged by corresponding conveyor belts (44, 45) extending in the X-direction and able to control the rotation or standstill of the axle. The third wheel (43) is coupled to a carriage (54) movable in the Y-direction by a third conveyor belt (48) and carrying the element to be displaced. Each of the two conveyors (41, 42) is controlled by a pair of stepper motors (10, 16) which allow small and accurate displacements to be realized.

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ELEMENT MOVING DEVICE

The present invention relates to an element moving device including a supporting structure movable in a predetermined direction and having a rotatable axle coupled to a movable element, means to exert forces, and first and second transmission means controlled by said force exerting means and able to control the displacement of said axle in said direction as well as the rotation of said axle, said first transmission means operating directly on said axle.

Such a device is already known from Belgian patent No 897 194 (J. VERHAEGHEN 3). Therein the rotatable axle is constituted by the first end of a rotatable first arm whose second end is coupled with the movable element and an intermediate point of which is hingedly connected to a second end of a second arm. The first and second transmission means are able to displace the first ends of both the arms in the predetermined direction, so that a simultaneous and like displacement of these first ends gives rise to a displacement of the movable element in the predetermined direction, whereas a relative displacement of these first ends provokes a rotation of the first arm and therefore also of the axle.

A drawback of this known device is that the second transmission means are coupled to the axle via the linked arms and that the linking points can adversely affect the accuracy with which the element can be brought in a predetermined position of a plane.

An object of the present invention is to provide

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an element moving device of the above type, but which does not present such a drawback and realizes a displacement and/or rotation of the axle in a simple way.

According to the invention this object is achieved  
5 due to the fact that also said second transmission means operate directly on said axle which is able to be rotated in either one of two selectable directions of rotation by each of said first and second transmission means.

Hence, no linking arms are required between the  
10 second transmission means and the axle so that a greater accuracy can be realized. Also the transmission means can impart a displacement and/or a rotation to the axle in a simple way. Indeed, a pure displacement of the axle is obtained when both transmission means exert opposite equal  
15 torques thereon; a pure rotation of the axle is realized when both transmission means exert thereon equal torques in the same direction; and a combined displacement and rotation of the axle is obtained when different torques are exerted on this axle.

20 Another drawback of the known device is due to the fact that the movable element is coupled to the rotatable axle via the first arm so that a rotation of this arm gives rise to an angular displacement of its second end with which the movable element is coupled. To bring this element in a  
25 predetermined point of a plane a relatively complicated control of the transmission and of the force exerting means is therefore required.

Another object of the present invention is to  
provide an element moving device of the above type but which  
30 also does not present this drawback.

According to the invention this object is achieved  
due to the fact that said rotatable axle is coupled to a carriage via third transmission means which are able to  
displace said carriage in a second direction, said carriage  
35 forming part of said element and the first mentioned direction

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as well as said second direction being both rectilinear.

In this way a rotary movement of the axle is transformed into a rectilinear displacement of the element in the second direction so that the control of the first and second transmission means and of the force exerting means to bring the movable element in a predetermined part of a plane can be relatively simple.

The above mentioned and other objects and features of the invention will become more apparent and the invention itself will be best understood by referring to the following description of an embodiment taken in conjunction with the accompanying drawings in which :

Fig. 1 is a schematic perspective view of an element moving device according to the invention; and

Fig. 2 is a schematic perspective view of part II of Fig. 1.

The element moving device shown in Fig. 1 includes a frame generally indicated by reference numeral 1 and the central part of which is cut away. This frame 1 includes a housing 2, a supporting plate 3 and brackets such as 4, 5, 6 and 7. Inside the housing 2 the shafts 8 and 9 of main stepper motors 10 and 11 are rotatably mounted in a not shown but obvious way respectively.

As shown in more detail in Fig. 2, the larger part of a T-shaped plate 12 which extends below the housing 2 is fixed on the upper side of the body of motor 10, whilst the smaller part of this plate 12 carries an axle 13 in which a nut 14 is mounted in a freely rotatably way. The screw treaded shaft 15 of an auxiliary stepper motor 16 engages with the nut 14. The motor 16 is mounted on a piece 17 which is pivoted about an axle 18 fixed in a support 19 secured to the lower side of supporting plate 3.

The main stepper motor 11 and an auxiliary stepper motor 20 are mounted and connected in a similar way as the stepper motors 10 and 16 respectively.

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At the upper side of housing 2 toothed wheels 21 and 22 are fixedly mounted on the upper ends of the above mentioned motor shafts 8 and 9 respectively. This housing 2 also carries two freely rotatable rollers 23 and 24, and the above mentioned brackets 4 and 5 carry freely rotatable toothed wheel 25 and wheel 26 respectively. The wheels 21 and 25 are mounted in a same plane and the same is true for the wheels 22 and 26 and the rollers 23 and 24.

Two longitudinal guide rods 27 and 28 are fixed in the above mentioned brackets such as 6 and 7. A supporting structure or sled 29 which is integral with a cantilever bridge piece 30 which constitutes another supporting structure is slidably mounted on the guide rods 27 and 28 as it is provided at its lower and upper sides with guide pieces such as 31, 32 and 33 which engage with these rods. The cantilever bridge piece 30 extends in a Y-direction perpendicular to the X-direction of the guide rods 27 and 28. The sled 29 carries fixedly mounted axles 34 and 35 on which respective pairs of rollers 36, 37 and 38, 39 are mounted in a freely rotatable way, as well as a fixed axle 40 about which an assembly of like toothed wheels 41, 42 and 43 is freely rotatable. Wheel 41 is located in the same plane as the wheels 21 and 25 and the rollers 36 and 38, and an endless toothed conveyor belt 44 engages with these wheels and rollers. Wheel 42 is located in the same plane as the wheels 22 and 26 and the rollers 23, 24, 37 and 39 and an endless toothed conveyor belt 45 engages with these wheels and rollers. The cantilever bridge piece 30 carries a bracket 46 bearing a freely rotatable toothed wheel 47 which is located in the same plane as wheel 43, an endless toothed conveyor belt 48 engaging with these wheels. Lateral walls of the bridge piece 30 are provided with T-shaped elements 49 and 50 respectively, the latter element 50 being visible through a cut-out portion of the bridge piece 30. These T-shaped elements constitute guide pieces for rollers such as 51, 52, 53 of a displaceable

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10, 16 and conveyor belt 44 by making reference to Fig. 2.

By each step of the main motor 10 its shaft 8 is rotated over a predetermined unit angle and the conveyor belt 44 is displaced over a predetermined unit distance.

5 This means that in this way the conveyor belt 44 can only be displaced over multiples of this unit distance. However, by the use of the auxiliary motor 16 this displacement can be regulated to a fraction of this unit distance. Indeed, supposing, for simplicity reasons, that a step of this auxiliary motor 16 produces a same unit angular displacement of 10 its shaft 15, as does the main motor 10 with its shaft 8, only a fraction of this unit angular displacement is communicated to the plate 12 due to the fact that the shaft 15 is screw threaded. By this angular displacement the stator 15 or body 10 of the main motor 10 is pivoted around the axis of its shaft 8 over the same angle. Since the motor 10 is a stepper motor it has a so-called holding torque, i.e. the torque which keeps its rotor in well defined positions with respect to its stator. Hence, the last mentioned angular 20 displacement of the main motor body by the auxiliary motor is accurately transmitted to the shaft 8 and therefore also to the associated conveyor belt 44.

In a preferred embodiment use is made of stepper motors having an angular speed of 1000 rpm and wherein one 25 step corresponds to  $1/800$  of a rotation. The coupling between each main stepper motor 10, 11 and its associated conveyor belt 44, 45 is such that each step of the motor 10, 11 corresponds to a linear displacement of 0.2 millimeter of the belt 44, 45. The transmission ratio between the main stepper motor 10, 11 30 and its associated auxiliary stepper motor 16, 20 is equal to  $1/40$ , so that the belt 44, 45 may be displaced in steps of  $\frac{0.2}{40}$  mm.

Instead of stepper motors also other motors could be used as auxiliary motor.

35 In another embodiment (not shown) of the above

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described element moving device the bridge piece 30 and all the items 46 to 55 are replaced by an arm radially mounted on wheel 43. A rotative motion of this arm 40 is thus substituted for the rectilinear motion of the displaceable carriage 54 in the Y-direction.

By the use of suitable driving devices elements coupled to the carriage 54 or to the end of the last mentioned arm may also be displaced in vertical direction and/or rotated.

The device described above is particularly suitable for use in robots.

While the principles of the invention have been described above in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention.



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CLAIMS

1) Element moving device including a supporting structure (29) movable in a predetermined direction (X) and having a rotatable axle (41-42) coupled to a movable element (54, 55), means (10, 16; 11, 20) to exert forces, and first (44) and second (45) transmission means controlled by said force exerting means and able to control the displacement of said axle in said direction as well as the rotation of said axle, said first transmission means operating directly on said axle, characterized in that also said second transmission means (45) operate directly on said axle (41-43) which is able to be rotated in either one of two selectable directions of rotation by each of said first (44) and second (45) transmission means.

2) Element moving device according to claim 1, characterized in that said rotatable axle (41-43) is coupled to a carriage (54, 55) via third transmission means (48) which are able to displace said carriage in a second direction (Y), said carriage forming part of said element and the first mentioned direction as well as said second direction being both rectilinear.

3) Element moving device according to claim 1, characterized in that said axle (41-43) is driven by first driving means (10, 16) via a first conveyor belt (44) which when displaced in said direction (X) and in a predetermined sense tends to rotate said axle in a first direction of rotation and that said axle is also driven by second driving

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means (11, 20) via a second conveyor belt (45) which when displaced in said direction (X) and in said predetermined sense tends to rotate said axle in a second direction of rotation opposite to said first one, said first and second driving means constituting said force exerting means (10, 16; 11, 20) and said first and second conveyor belts constituting said first and second transmitting means respectively.

4) Element moving device according to claim 2, characterized in that said third transmission means are constituted by a third conveyer belt (48).

5) Element moving device according to claim 2, characterized in that said supporting structure (29) is constituted by a sled which is integral with a bridge piece (30) supporting said carriage and extending in said second direction (Y).

6) Element moving device according to claim 3, characterized in that each of said first (10, 16) and second (11, 20) driving means comprises a first (10, 11) and a second (16, 20) stepper motor, the stator of said first stepper motor being coupled to the shaft (15) of said second stepper motor through means (15,12) able to transform an angular displacement step of said shafts into a reduced angular displacement of said stator.

7) Driving device including a first (10) and a second (16) motor, characterized in that the stator of said first motor (10) is coupled to the shaft (15) of said second motor (16) through means (15, 12) able to transform an angular displacement of said shaft (15) into a reduced angular displacement of said stator.

8) Driving device according to claim 7, characterized in that each of said each of said motors is a stepper motor each of said angular displacements of said stator being a fraction of one angular step of said first motor (10).

FIG.1

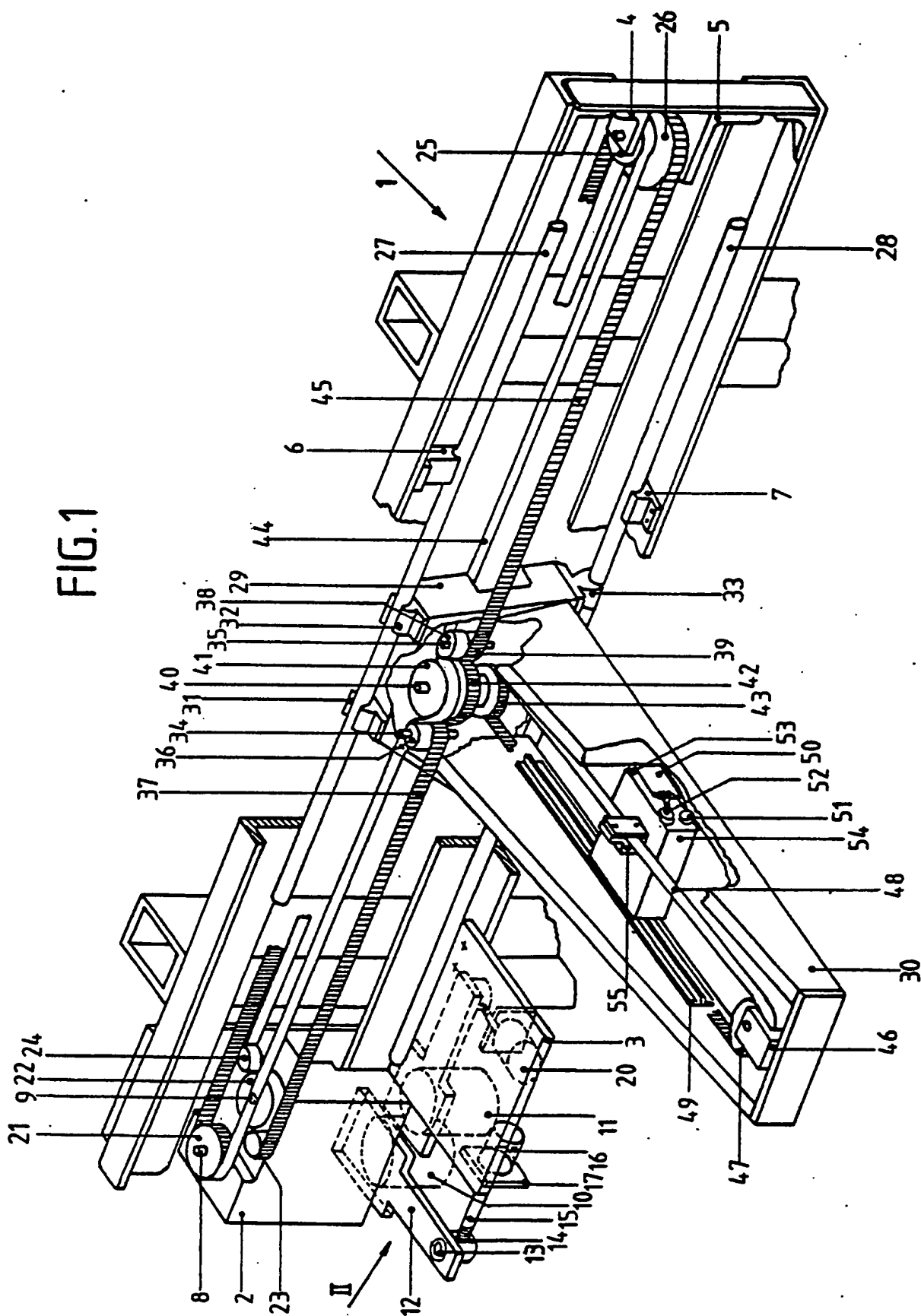
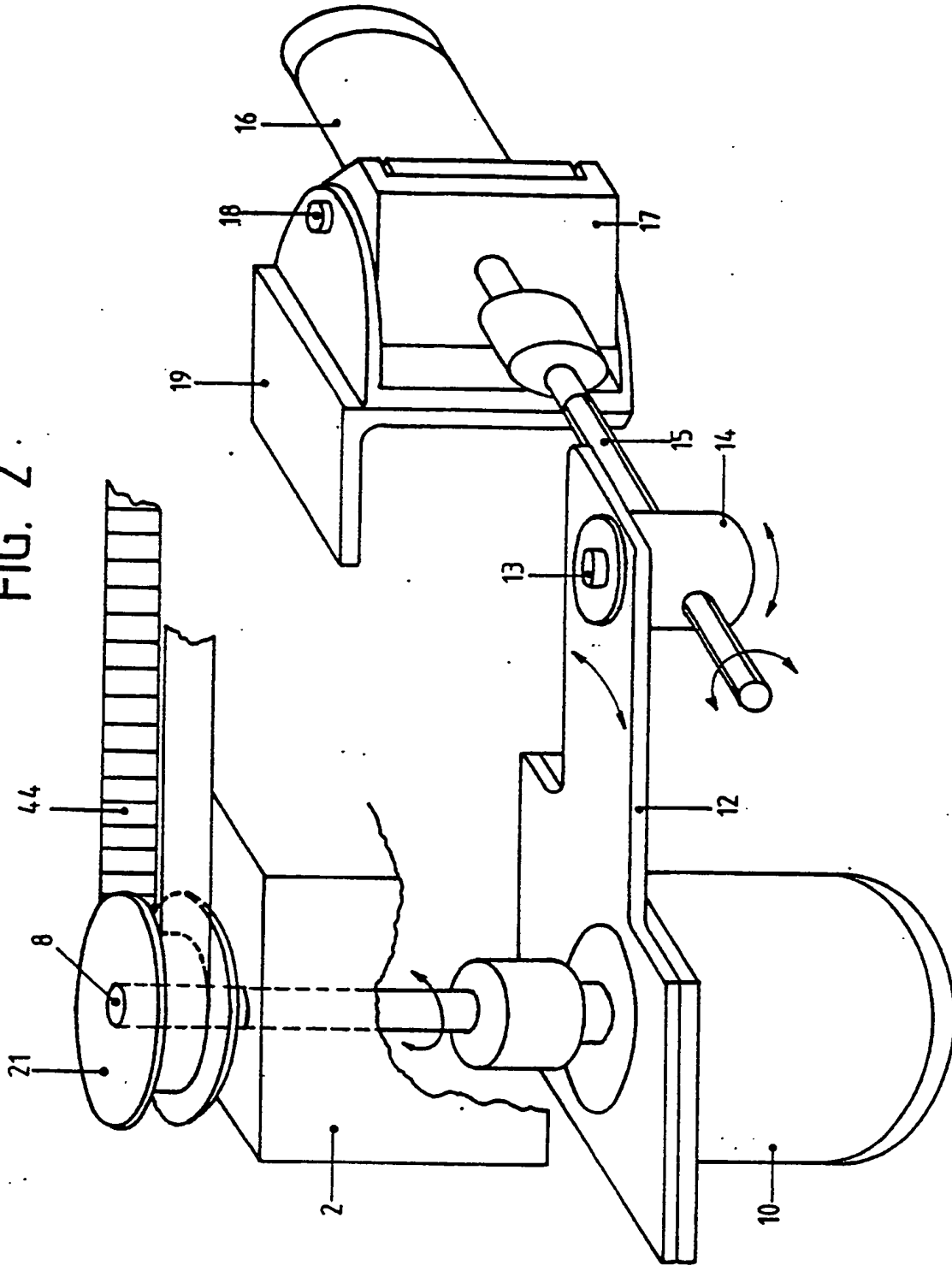


FIG. 2



# INTERNATIONAL SEARCH REPORT

International Application No PCT/EP 85/00496

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) <sup>6</sup> According to International Patent Classification (IPC) or to both National Classification and IPC. IPC <sup>4</sup> : B 65 G 61/00; B 65 G 47/90																	
<b>II. FIELDS SEARCHED</b> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin: 5px 0;">Minimum Documentation Searched <sup>7</sup></div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 20%; border-bottom: 1px solid black;">Classification System</th> <th style="border-bottom: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">IPC <sup>4</sup></td> <td style="padding: 5px;">B 65 G 47    B 25 J 17 B 65 G 61 B 25 J 9</td> </tr> </table> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin: 5px 0;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup></div>			Classification System	Classification Symbols	IPC <sup>4</sup>	B 65 G 47    B 25 J 17 B 65 G 61 B 25 J 9											
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IPC <sup>4</sup>	B 65 G 47    B 25 J 17 B 65 G 61 B 25 J 9																
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup></b> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; border-bottom: 1px solid black;">Category <sup>9</sup></th> <th style="border-bottom: 1px solid black;">Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup></th> <th style="width: 10%; border-bottom: 1px solid black;">Relevant to Claim No. <sup>13</sup></th> </tr> <tr> <td style="border-right: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="border-right: 1px solid black; padding: 5px;">FR, A, 2360485 (S.A. DE TELECOMMUNICATIONS) 3 March 1978, see figures; page 2, lines 19-23; page 3, line 25 - page 4, line 4 ---</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1</td> </tr> <tr> <td style="border-right: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="border-right: 1px solid black; padding: 5px;">EP, A, 0059477 (BENGTSOON) 8 September 1982, see figure 4; page 3, lines 17-23 ---</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1</td> </tr> <tr> <td style="border-right: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">P,X</td> <td style="border-right: 1px solid black; padding: 5px;">US, A, 4505166 (TESAR) 19 March 1985, see abstract; figure 4a ---</td> <td style="text-align: center; vertical-align: top; padding: 5px;">7</td> </tr> <tr> <td style="border-right: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="border-right: 1px solid black; padding: 5px;">FR, A, 2555492 (CENTRE D'ETUDES ET DE RECHERCHES EN MECANIQUE ET AUTOMATISME) 24 November 1983, see figure 1; page 1, lines 23-30 -----</td> <td style="text-align: center; vertical-align: top; padding: 5px;">7</td> </tr> </table>			Category <sup>9</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>	A	FR, A, 2360485 (S.A. DE TELECOMMUNICATIONS) 3 March 1978, see figures; page 2, lines 19-23; page 3, line 25 - page 4, line 4 ---	1	A	EP, A, 0059477 (BENGTSOON) 8 September 1982, see figure 4; page 3, lines 17-23 ---	1	P,X	US, A, 4505166 (TESAR) 19 March 1985, see abstract; figure 4a ---	7	A	FR, A, 2555492 (CENTRE D'ETUDES ET DE RECHERCHES EN MECANIQUE ET AUTOMATISME) 24 November 1983, see figure 1; page 1, lines 23-30 -----	7
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<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><sup>10</sup> Special categories of cited documents: <sup>10</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p> </div> </div>																	
<b>IV. CERTIFICATION</b> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;">Date of the Actual Completion of the International Search 17th December 1985</td> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;">Date of Mailing of this International Search Report 24 JAN. 1986</td> </tr> <tr> <td style="border-bottom: 1px solid black; padding: 5px;">International Searching Authority EUROPEAN PATENT OFFICE</td> <td style="border-bottom: 1px solid black; padding: 5px;">Signature of Authorized Officer  G.L.M. Knydenberg</td> </tr> </table>			Date of the Actual Completion of the International Search 17th December 1985	Date of Mailing of this International Search Report 24 JAN. 1986	International Searching Authority EUROPEAN PATENT OFFICE	Signature of Authorized Officer  G.L.M. Knydenberg											
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# ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/EP 85/00496 (SA 10810)

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		LU-A- 77920	17/11/77
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EP-A- 0059477	08/09/82	US-A- 4419039	06/12/83
US-A- 4505166	19/03/85	None	
FR-A- 2555492	31/05/85	None	

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